CENTRAL REGION INTEGRATED SCIENCE PARTNERSHIP FUNDS

Project Title: Evaluation of the Effectiveness of a Multi-disciplinary Approach for Predicting Post-Wildfire Erosion and Sedimentation

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Problem: Millions of dollars are spent annually to mitigate post-wildfire erosion and sedimentation hazards in the western U.S. Models exist that predict the magnitudes and spatial variations of the hazards, but these models have not been verified with data from burned basins. Measurements of erosion rates and mapping of sedimentation effects in basins burned by the Cerro Grande fire of 2000 in New Mexico allow, for the first time, an opportunity to evaluate the effectiveness of GIS-based models for predicting post-wildfire erosion and sedimentation.

Objective: The primary objective of this project is to evaluate the effectiveness of multi-discipline, GIS-based models for predicting post-wildfire erosion and sedimentation and, based on this evaluation, determine research directions that would lead to improved understanding of the physical processes and representations of the potential hazards.

Scope: The project will focus on Rendija canyon, which was burned by the Cerro Grande fire of 2000 near Los Alamos, New Mexico. The following four tasks will be accomplished: 1) a map depicting post-wildfire hillslope and channel erosion will be generated for Rendija canyon; 2) data layers consisting of variables considered to affect post-wildfire erosion and sedimentation will be assembled; 3) data layers will be combined into GIS-based models; and 4) model results will be evaluated by comparing the predicted results with the actual erosion and sedimentation map, the models will be refined accordingly; and recommendations will be made to guide future research directions.

Approach: In this project we will leverage parts of two existing projects for field data and satellite imagery. These projects include the USGS Venture Capital project on the evaluation of the ecological, hydrological, and geological consequences of burn severity and the Joint Fire Science Program project for validation of burn severity mapping from field data.
Task 1) Field measurements and characterizations of hillslope and channel erosion rates, coupled with mapping and measurements from 1:6000 scale aerial photographs, will be used to generate a map of the post-fire erosion and sedimentation in each of the 15 sub-watersheds of Rendija canyon.
Task 2) Post-wildfire erosion and deposition depends on many variables. In this effort we will use the best data available. Measures of topographic parameters (sub-watershed size, gradient, curvature, etc) will be derived from digital elevation models (DEMs). We will characterize burn severity for each sub-watershed by the Normalized Burn Ratio (NBR), which has been determined from Landsat Thematic Mapper data (Key and Benson, 2000)[1].

[1] References available upon request.

A measure of the vegetation remaining in the sub-watersheds after the fire will be obtained from airborne Advanced Visible/InfraRed Imaging Spectrometer (AVARIS) data provided by collaborators at Los Alamos National Laboratory. In addition, measures of soil texture and erodibility and geologic lithology will be obtained from existing maps.

Task 3) In this task, the data layers will be incorporated into models for erosion and sedimentation potential that are conceptually similar to the Revised Soil Loss Equation (RUSLE). Initially, we will follow the approach outlined in MacDonald et al. (2000)[1], where the effects of each variable are considered equal and the different measures are linearly ranked.

Task 4) We will compare the model results with the actual erosion and sedimentation map on a sub-watershed scale. Statistical comparisons of the model results with different combinations of variables will be used to identify the variables that best predict erosion and sedimentation potential. This analysis can lead to model refinements. In addition, this process will lead to the identification of the physical relations in post-wildfire erosion and sedimentation that need further definition and understanding.

Benefits: If the GIS-based models prove to be reasonable in their depiction of the erosion and sedimentation potential of recently-burned sub-watersheds, this project will provide land managers with valuable tools for evaluating the potential erosional and depositional response of recently burned basins. These tools are necessary for the design and implementation of effective post-wildfire watershed rehabilitation measures.

This project represents the combined expertise, efforts and data sources of personnel from all four disciplines within the USGS.

Outcome/Products: This project will produce a publication that evaluates the use of GIS-based models to predict post-wildfire erosion and sedimentation using actual measurements of erosion and sedimentation. In addition, we expect to define areas where future discipline-integrated research could serve to improve the understanding of the physical controls on post-wildfire erosion and sedimentation.

Budget: We request gross funding of $50K for the following activities:

20 K: Generation of actual erosion and sedimentation map - Martin, Moody and Cannon

20 K Data layer compilation and generation of predictive erosion and sedimentation maps – Zhu, in consultation with Martin, Moody, and Cannon

5 K Compilation of burn severity index data – sub-catchment and pixel scales – Key

5 K Compilation of AVARIS data – sub-catchment and pixel scales – Kokaly

Timeline:

Completion, in months from receipt of funding	**Task**
9	Compilation of erosion and sedimentation map for Rendija canyon
9	Assembly and compilation of data layers
10	Development of models and generation of maps depicting model results
11	Evaluation of map effectiveness
12	Production of report describing models, effectiveness, and suggested future science directions